The Duration of Pregnancy, with a New Rule for Its Estimation.

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THE DURATION OF PREGNANCY, WITH A NEW RULE FOR ITS ESTIMATION.

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The duration of human pregnancy is a question which has been debated by medical men of all ages. The extent of our ignorance has been but little decreased since the devout remark of the great Arabian physician, Avicenna, that "at the appointed season labor comes on by command of God." This observation is generally admitted to be correct. The study of the question is obscured by the difficulty of knowing with exactitude the date of coitus; and when the date of a single coitus is known, it is clear that conception may occur at any day before the first missed menstruation. The length of time during which spermatozoa may live in the vagina and uterus before conception is still unknown, but there is no doubt that this may be for a number of days.

For this reason, in our estimation of the duration of pregnancy it is customary to reckon from the first day of the last menstruation. This allows for an error in the reckoning of at least three weeks. Ovulation is by no means limited to menstruation, and fecundation may take place at any time during the interval between two menstrual periods. Often, however, when there has been but a single coitus, the day of copulation is also the day of conception, or the first day of pregnancy. A number of such cases of conception after a single intercourse were collected by Reid,[1] in which 25 of 43 cases showed the duration to be from 270 to 280 days reckoning from the single intercourse, and in 11 cases pregnancy was prolonged beyond 280 days. One case was delivered 300 days after the single intercourse. Isolated cases of pregnancy after a single coitus have since been reported; but no such large series has been collected.

Observation on animals, particularly cows, whose time of pregnancy is nearest to that of women, have shown that their period of gestation is by no means a fixed time, but may vary from 240 to 321 days. Tessier's[2] researches, conducted with unusual care over

[1] Lancet, 1850.

[2] Mémoires de l'Académie Royale de Science de l'Institut de France, 1819, ii, 1.

a period of forty years, showed that, while the average duration of pregnancy of cows was 285 days, 321 calved between the 280th and 297th days, 6 at the 298th day, 4 at the 299th day, and 10 between the 300th and 321st days. Earl Spencer s experiments in 724 cases corroborate those of Tessier in that 310 cases calved before the 284th day and 314 after the 285th day. While the variation of the duration of pregnancy in cows is no proof of a similar variation in the human animal, it is at least suggestive that a similar variation may or does occur in pregnancy in women.

There is no doubt that pregnancy in women may be prolonged in a certain percentage of cases, and numerous instances of abnormally long pregnancy have been reported. Winckel[3] has collected 20 cases which he has discussed in detail, and has accepted 6 cases as authentically proved prolonged pregnancy of 310, 311, 312, 324, and 336 days, with children weighing from 5770 to 7470 grams. Nine of the remaining cases he rejects as not proved, and five were not completely satisfactory. Many other isolated cases have been reported, such as those of Allen[4] and many others.

While it is difficult in many cases to estimate exactly the probable time of conception, it is conceded by obstetricians generally that prolongation of pregnancy does occur, and that the children of such pregnancies are remarkable for their large size. It is also believed that a proportion of overweight children are carried for more than the average time of pregnancy. While admitting that isolated observations prove nothing in this connection, it is evident that the average duration of many hundred cases weighing 4000 grams, and over, must have considerable force. Winckel has collected 245 cases of this great weight and estimated the duration of the pregnancy as follows, as to the time after the last menstruation:

Duration of pregnancy in days.	After last menstruation.
241 to 260	3.7 per cent.
261 to 270	6.1 "
271 to 280	18.3 "
281 to 290	38.0 "
291 to 300	18.8 "
301 to 310	8.5 "
311 to 336	6.6 "

This collection shows that it is not an isolated occurrence that heavy-weight children are carried beyond the ordinary term of pregnancy; but it is a fairly definite proof that children are often overweight because they are carried for longer than the ordinary term. While it is true that large infants may be the result of short pregnancies, as was the case in 3.7 per cent. of these cases, it is more common that heavy children are the result of pregnancies

[3] Leyden's Deutsche Klinik, ix, 5 to 10.

[4] Amer. Jour. Obst., 1907, lv, 4.

longer than the average 280 days, as was the result in 71.8 per cent. of this series.

In 31 of the larger babies with an average length of 53.8 cm. and an average weight of 4276 grams, the prolongation of the gestation period was 31 days, counting from the last menstrual period. The average prolongation of the gestation in infants weighing 4000 grams, or slightly less than the preceding, was 8.22 days, reckoning in the same way from the last menstruation. Thus, also, in children weighing 4000 grams it was found that 30, or 12.2 per cent., had a gestation period of longer than 302 days, the legally determined duration of pregnancy in Germany.

Blau and Christofoletti[5] also have collected the cases of large children from 68,032 births in the clinics of Schauta and Chrobak for the years 1892 to 1901, in order to determine the correlation of large children and protracted gestation. Among 1778 children weighing more than 4000 grams the pregnancy lasted more than 300 days in 150 cases, and more than 302 days in 135 cases.

There seems, therefore, to be conclusive proof that pregnancy may persist for longer than 280 days, and that, when it is prolonged over term, the resulting child is commonly of large size. These cases cited were clinic cases where conditions were not favorable to large children, as repose favors the increase in weight of the child. Rest, as has been proved by Pinard,[6] is a factor which may distinctly prolong the pregnancy. This may explain the difference between gestation in summer (277.2 days) and winter (279.5 days) or between married (282.4 days) and unmarried (278.2 days), as has been shown by Pinard.[7] This influence of quiet and rest will also explain the larger number of heavy children found in private practice, as the luxury of a home influences the weight of the fœtus. Letournier[8] has shown that women who have fatiguing work to do have children lighter in weight than those who are able to rest during their gestation. He found an average difference of 220 grams between these classes.

The type of menstruation, the sex of the fœtus, and heredity are all said to have effect upon the size of the fœtus and the duration of pregnancy; but none are proved to have any influence.

On the other hand, constitution and habitus do seem to have an influence, as Issmer[9] found an average duration of 278.6 days in robust women, and 276.8 days in weak women. He also states that there is an average increase of weight of the child in each pregnancy of 224.5 grams. The first child is the smallest, as a rule,

[5] Monats. f. Geburtsh. u. Gyn., 1904.
[6] Dictionnaire de Physiologie, 1905, article Gestation.
[7] Clinique Obstétricale, 1899, 51.
[8] Thése de Paris, 1897; De l'influence de la profession de la mère sur le poids de l'enfant.
[9] Arch. f. Gyn., xxx, 277, and xxxv, 310.

and each succeeding pregnancy produces a larger child up to the ninth.

Another artificial cause of prolonged pregnancy is the performance of the operation of ventrofixation of the uterus. A number of long pregnancies with very large children have been reported after this operation. The most likely explanation is that the unequal development of the uterus and the thinning of the posterior wall causes the cervix to be displaced in its relation to the pelvic axis. The early pains, being weak from the thin walls, are not able to press the presenting part into the os to bring about dilatation. From the various reports it appears that the pains came on and passed off again several weeks before birth actually occurred.

The following list of cases shows the tendency toward the prolongation of pregnancy, and forms another argument against the performance of this operation in child-bearing women:[10]

Author.	Para.	Last menstruation.	Labor.	Duration of pregnancy.
Kissler,	2	February, 1903	December 10, 1903	About 43 weeks.
Lynch,	4	11 months antepart.	April 9, 1902	About 44 weeks.
Fuchs,	8	June 4, 1898	March 29, 1899	About 43 weeks.
Kallmonger,	2	August 18, 1897	June 16, 1898	About 43 weeks.
Rick,	3	March 17, 1897	January 16, 1898	About 43 to 44 weeks.
Rick,	5	June 24, 1896	April 5, 1897	About 41 weeks.
Rick,	6	March 28, 1897	March 28, 1898	About 52 weeks.
Stahler,	2	3 weeks overdue	.....	About 43 weeks.
Ahlfeld,	3	Middle of May, 1902	March 19, 1903	About 44 weeks.
Ahlfeld,	3	March 26, 1905	January 10, 1906	41 to 42 weeks.

This phase of the subject is worthy of further study, and it would be well if those reporting cases of pregnancy after anterior fixation should note the duration of pregnancy and the weight and length of the child.

While thus it may be seen that many factors affect the duration of pregnancy, Issmer has also estimated that the size of the fœtus bears a relation, as a rule, to the duration of pregnancy, as follows:

48 cm. length averages	271.3 days.
49 cm. length averages	278.4 days.
50 cm. length averages	277.1 days.
51 cm. length averages	282.5 days.
52 cm. length averages	283.6 days.
53 cm. length averages	286.5 days.
54 cm. length averages	290.0 days.

He states that there may be a difference of ten to eighteen days in the duration of pregnancy; but, basing his statements on the average of his large collection of cases, he says that the larger the child the longer is the pregnancy, and that the increase is in the proportion of his table. Large children do also occur in shorter pregnancies, but they are much more infrequent than when the pregnancy is prolonged.

[10] Deutsche med. Woch., 1906, vii, 250. See complete literature.

These variations in the duration of pregnancy make it difficult to prognosticate the date of labor. If the usual rule is applied of adding seven days and subtracting three months from the date of the last menstruation, the estimate may be three weeks out of the way; but basing it upon the average duration of pregnancy, it is often correct. However, conception may have occurred immediately before the first missed menstruation, and so give a factor of error.

Schatz,[11] in two abstruse papers, has claimed that pregnancy is divided into physiological double months and periods of various kinds, and claims that labor occurs at the termination of one of these. It is based upon the electric tension of the air, as shown by Arrhenius to be 27.3 days and which Schatz claims to be paralleled by the average duration of menstrual periods. This theory differs but in the complexity of its language from that held by ancient obstetricians, that labor occurred upon the date of a menstrual period. Unfortunately, however, there is no such exactitude, and the obstetrician must continue to take his fitful rest with one ear, cocked, listening for the telephone bell announcing the advent of a labor, the date of which he has no means of exactly determining.

Since, however, the attempt to estimate the duration of pregnancy by the number of days is inexact, it might be well to attempt to estimate the duration of pregnancy from the size of the fœtus. For, if the fœtus may be measured and the average size of the fœtus is known, the date of labor will be when the fœtus arrives at average size in the great majority of cases.

So, with the hope of being able to determine the date of labor, I have evolved a rule which is dependent upon the height of the fundus of the uterus above the symphysis. The height of the fundus is dependent upon the occipitococcygeal measurement of the child, and this varies in direct proportion to the weight of the child, as does the length. The details of this proportion have been worked out in a previous paper.[12]

The rule is as follows: The duration of pregnancy in lunar months is equal to the height of the uterus in centimeters divided by 3.5. It depends upon the more or less regular growth of the uterus of 3.5 cm. each month of four weeks, and is very exact after the sixth month. The measurement is taken with the patient lying flat (see figure), and one end of the tape is placed at the upper border of the symphysis, while the other is held by the thumb into the palm of the hand. The fingers of the upper hand are held at right angles to the fundus of the uterus, and the tape follows the contour of the uterus save at the last dip, as is shown in the illustration. Multiparæ with lax abdominal walls and thin uteri should be supported at the side, so as to bring the occipitococcygeal axis of the pelvis into the long axis of the mother's body.

[11] Arch. f. Gyn., lxxxiv, 2, and lxxx, 3.

[12] Mensuration of the Child in the Uterus, Jour. Amer. Med. Assoc., December 15, 1906.

This method gives satisfactory results and is the most exact means of estimation of the duration of pregnancy. It is strictly an estimation of the size of the fœtus; for when the uterus arrives at the height of 35 cm., or full term ($\frac{35}{3.5}$ = 10 lunar months), the fœtus is of a weight of 3300 grams, or average size, as is shown by the measurements in my former paper. Thus, an average-sized baby usually comes at the average period of pregnancy—hence the rule.

After the sixth month this rule is extraordinarily exact, and is most useful in determining the date of labor and the size of the fœtus, when the date of the last menstruation has been forgotten. It has been in use in my hands since 1904, and I have had good reports of it from many obstetricians, including some of my German confrères. Hamilton has reported it to me to be of great use in asylum practice in insane pregnant women who are not able to give a connected history of menstruation.

Author's rule: The duration of the pregnancy in lunar months equals the height of the uterus in centimeters divided by 3.5.

It may be said that 35 cm. is the usual height of the uterus at full term with a fœtus of 3300 grams. For every centimeter of height above this measurement approximately 200 grams should be added to the weight of the fœtus. Thus, a uterus measuring 37 cm. would contain a fœtus weighing 3700 grams. The measurements are more exact below 35 centimeters, than above that height.

The so-called "sinking" of the fœtus in the last two weeks of pregnancy causes but little error in the measurement, as the head, when the patient is recumbent, rides upward on the pelvic bones and the sinking is not a factor. "Sinking" in my experience is not common in primiparæ, and its supposed presence is often due to the stretching of the abdominal muscles and not to descent of the head into the pelvis. The fundus thus comes lower in the erect position, and no diminution of the fundal height is noted in

the recumbent. This is well shown in Hirst's[13] photographs of women at various periods of pregnancy. "Sinking" does, however, in multiparæ sometimes complicate the measurement, but not often. Hydramnios also causes but small error, as the excess of liquid does not affect the fundus, but the body of the uterus, leaving the height of the fundus to be determined by the occipitococcygeal measurement and the size of the fœtus.

The rule gives the most exact means at hand of prognosticating the date of labor. No rule can be exact when dealing with such an uncertain quantity as the duration of pregnancy, save that in the majority of cases an average-sized baby is born at the average time.

Thus, if the fundus measures 26 centimeters from the symphysis, the duration of pregnancy is 26 divided by 3.5 or $7\frac{3}{7}$ lunar months, and the patient has $2\frac{4}{7}$ lunar months to go to term, or ten weeks and two days.

This rule, combined with the estimation of pregnancy by reckoning from the last menstruation, gives a fairly exact determination of the probable date of labor.

While the rule is useful for the determination of the date of labor, it is still more useful for the determination of the size of the fœtus, with a view to induction of labor for contracted pelvis or other cause. When the fundal measurement is at or near 35 cm., I never hesitate to induce labor when indicated, knowing that there is a fœtus of the average weight of about 3300 grams and capable of standing instrumental delivery and not liable to die from prematurity.

When used for the purpose of estimating the size of the child in contracted pelvic or other conditions, it should be used in conjunction with the other methods of measuring the head, etc., as noted in my previous paper on this subject.

[13] Text-book of Obstetrics.